

Ontario. Ministry of the
Environment.

Report on an investigation of
a die-off of vegetation in a
sewage treatment lagoon at Wahnapitae,
Ontario.

1984.

LIBRARY COPY

JUN 1984

MINISTRY OF THE
ENVIRONMENT

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

Report on an Investigation of a
Die-off of Vegetation in a
Sewage Treatment Lagoon at Wahnapiatae, Ontario

February 1984
Prepared by:

W. D. McIlveen
Plant Pathologist

NER-AQTM-09-84

Introduction

Sewage treatment lagoons were constructed immediately south of the village of Wahnapiatae, Ontario in 1981. This lagoon system is comprised of three separate cells totalling about 15.5 ha in area (Figure 1). The cells are discharged annually to the Wanapitei River following treatment of the sewage. The lagoon system was constructed on a low-lying bank of the river where natural vegetation (primarily cattails and rushes) was able to re-establish stands on the bottom of the cells following the lagoon construction activities.

In the fall of 1982, the sewer system at Wahnapiatae was brought into service and the most southerly cell (Cell 3) was filled with sewage. In the summer of 1983, it became apparent that large areas of the stands of cattails in this cell were dead. This die-off was of concern since it was expected that this vegetation would assist in removing nutrients from the sewage effluent. A request for assistance in this matter was made to the Ontario Ministry of the Environment by the Regional Municipality. This report includes the results of that investigation.

Site Visit and Sample Collection

At the time of the investigation, September 8, 1983, it was found that Cell 3 was partially filled with sewage. This was estimated to be mostly less than 1 metre in depth but no attempt was made to actually measure this depth. A small patch (about 25 m across) of vigorous and healthy cattail growth was present at the west end of this cell. There were also small scattered clumps of slightly smaller plants at a few other locations as well. A large portion (primarily in the north and west areas) of the cell contained the remnants of cattails which had grown in 1982. The majority of these had been broken off fairly uniformly at about 10cm above the water level present on September 8, 1983.

In Cell 2, the middle cell, the water was shallow and clean, being at a lower level than that of Cell 3. The vegetation, although not dense, was considered to be healthy except for some minor fungal infections, and consisted of cattail and rushes.

Samples of cattail foliage (*Typha latifolia*) from above the water line were collected from a canoe. Three samples were collected from Cell 3 representing 3 separate locations within the lagoon (east end, middle and west end) and from 2 locations in Cell 2 (east end and west end) (Figure 1). The samples were placed in polyethylene bags and returned to the laboratory. The samples were oven dried at 80°C for 48 hours, ground in a Wiley mill and forwarded to the MOE Resources Road Laboratory in Toronto for analysis. The analyses included nitrogen (total Kjeldahl), phosphorus, potassium, calcium, iron, cadmium, cobalt, copper, nickel, lead and zinc.

Results and Discussion

The chemical analysis results for the vegetation samples are presented in Table 2. The concentrations of all elements were within the range

considered to be normal. Nitrogen, phosphorus, cadmium, cobalt, copper and nickel contents of the vegetation were essentially the same in both cells. Potassium and calcium concentrations were higher in samples from Cell 3 than samples from Cell 2. The reverse occurred in the case of iron, lead and zinc which were slightly higher in Cell 2 than in Cell 3. In all cases the differences were considered to be much too small to be of significance. The concentrations of all elements were much too low to indicate any problem of toxicity to the vegetation.

If a toxic material had been involved with the death of the cattails, all plants would first have shown a decline in growth, a reduction in vigor or the presence of injury symptoms but none of these conditions was observed. In fact, the cattails remaining were judged to be quite healthy. Since we can effectively rule out the possibility of toxic agents and disease problems, we must look at the major change which took place in the previous year, namely the filling of the lagoon itself. During the filling process in the winter of 1982-83, the water levels rose one to one and a half meters possibly covering some of the plants. Only the tallest plants would remain above the high water line. These would be those plants growing in the area with the greatest amount of moisture and the greatest nutrient pool. These conditions would naturally occur at the west end of the lagoon due to the sloping of the bottom of the lagoon required for drainage purposes. In fact, the greatest majority of the surviving cattails were observed in the west end of Cell 3. Observations made by the lagoon operators suggested that the cattail plants were never completely submerged by the sewage during the winter of 1982-83.

In the course of the investigation, it was necessary to review the available literature to determine if these were other instances of cattail deaths which could involve similar mechanisms. The literature provided some support for the explanation that raised water levels can cause die-off of emergents (vegetation which extend above the water line) in natural marshes.

Emergent die-offs have been reported as a natural phenomenon of Great Lakes shoreline marshes (Geis, 1979; Jaworski and Raphael, 1976; McDonald, 1955). The mechanism of emergent die-offs has been studied by McDonald (1955), Geis (1979), Mathiak (1971), and Millar (1973). During the summer and winter, emergent vegetation requires oxygen, which it can obtain from aerial shoots which have special cells to transport air to the rhizomes (underwater portions of the plants) (Linde, Janisch and Smith, 1976). Even during the winter, dormant rhizomes still require oxygen. These rhizomes can endure anaerobic (no oxygen) conditions for up to 13 days (Linde, Janisch and Smith, 1976). During a normal winter, the dead aerial shoots of emergents can transport air to the rhizome, as water levels are usually lowest at this time of the year.

There is no doubt that high winter water levels can induce a total die-off of emergent vegetation (McDonald, 1955; Geis, 1979; Mathiak, 1971; Millar, 1973). When a natural die-off of emergents occurs recovery of the vegetation is usually rapid once water levels subside (Geis, 1979).

It has been reported that the rising water levels in a marsh system could cause the buoyant ice to lift up large beds of vegetation caught in the ice. Roots and rhizomes are dislodged and a general disruption of bottom sediments occurred. Similar situations have been observed in marshes (Geis, 1979; Mathiak, 1971). This precludes any regeneration of emergents from surviving rhizomes in the root mats.

It is known that emergents require bare mud flats in the spring to germinate (Harris and Marshall, 1963). When water levels return to normal, emergent and submergent vegetation will more readily become re-established. Another factor which could prevent emergent regeneration is heavy sedimentation, which may prohibit seedling development.

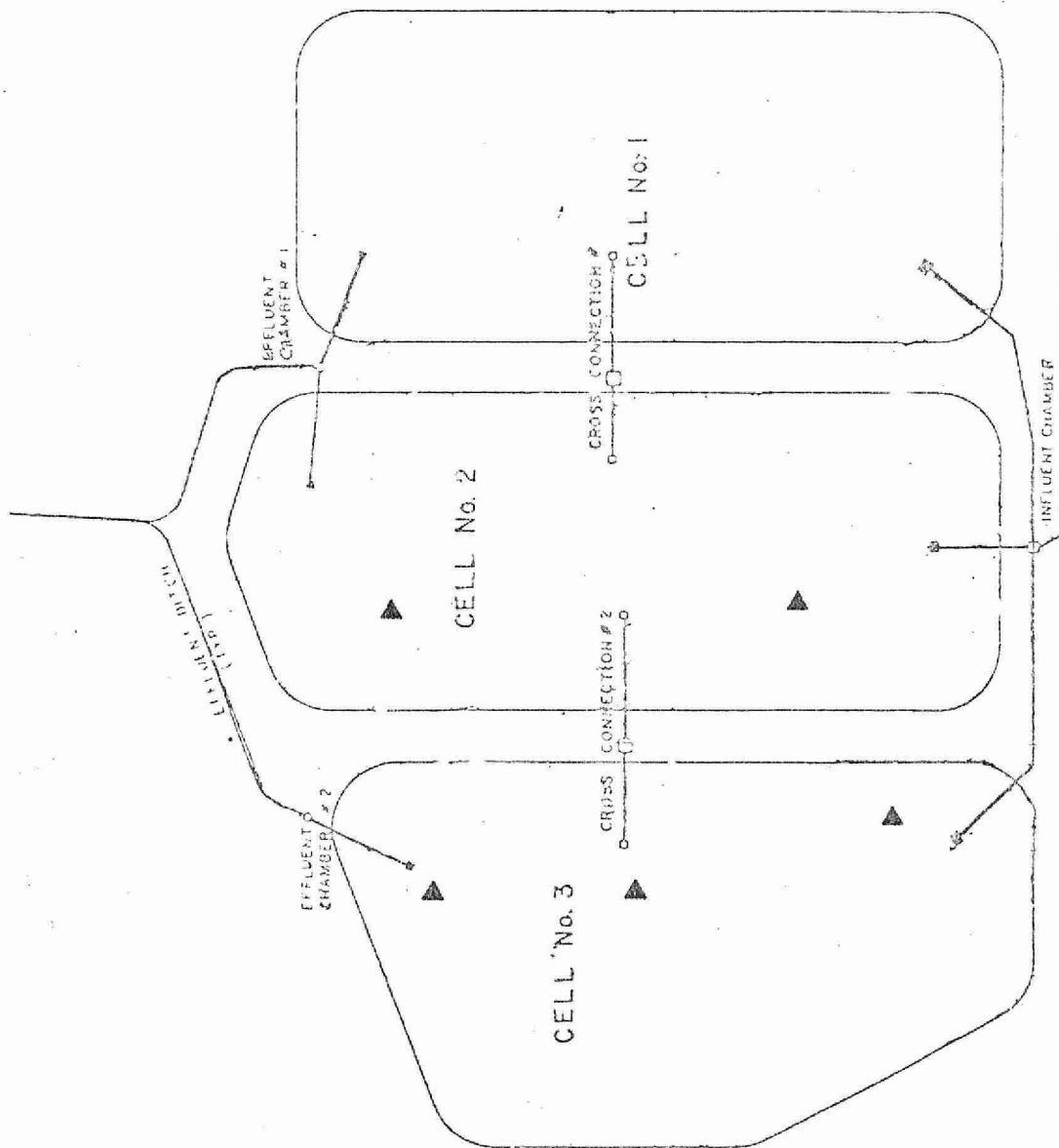
We have therefore concluded that the cattail plants died from a lack of oxygen supply to the roots. The high oxygen demand by other biological activity in the sewage water in the cell no doubt created an increased stress on the overwintering plant parts on the bottom of the lagoon. This is a situation which had never occurred previously, hence the plants were unable to withstand the new stress created by the sewage water. Although the stems extended above ice level, they were unable to transport oxygen at a sufficient rate to satisfy the needs of the rhizomes.

Summary

The Ontario Ministry of the Environment has conducted an investigation into the severe die-back of cattail vegetation in the sewage treatment lagoons at Wahnapiatae, Ontario in 1983. The die-back was attributed to a lack of oxygen supply to the overwintering portions of the plants created as the sewage water level was raised in the lagoon. Samples of surviving cattails showed normal concentration of several elements, thereby eliminating the possibility that a toxic agent was involved in the death of the plants. It is unlikely that the cattails will be re-established from seed as long as sewage covers the bottom of the lagoon but is probable that the surviving plants will recolonize the area by vegetative propagation of the rootstalks.

R42-B

Figure 1.



Wahnapiatae Lagoon

▲ - Sample site for cattail collection

Table 1 - Concentrations of Several Chemical Elements in Samples of Cattail Foliage Collected at the Wahnapiatae Sewage Lagoons, September 8, 1983.

Element	East End	Cell 1 Used		Cell 2 Not Used	
		Middle	West End	East End	West End
Nitrogen (%)	0.32	0.17	0.23	0.18	0.23
Phosphorus (%)	0.23	0.13	0.17	0.19	0.23
Potassium (%)	1.84	2.16	3.00	1.46	1.83
Calcium (%)	0.93	0.86	0.80	0.66	0.68
Iron (ug/g)	40	20	30	90	130
Cadmium (ug/g)	0.3	0.2	0.5	0.4	0.2
Cobalt (ug/g)	>1	>1	>1	>1	>1
Copper (ug/g)	10	10	9	8	11
Nickel (ug/g)	25	13	14	12	34
Lead (ug/g)	2	2	1	3	4
Zinc (ug/g)	8	6	8	14	10

References

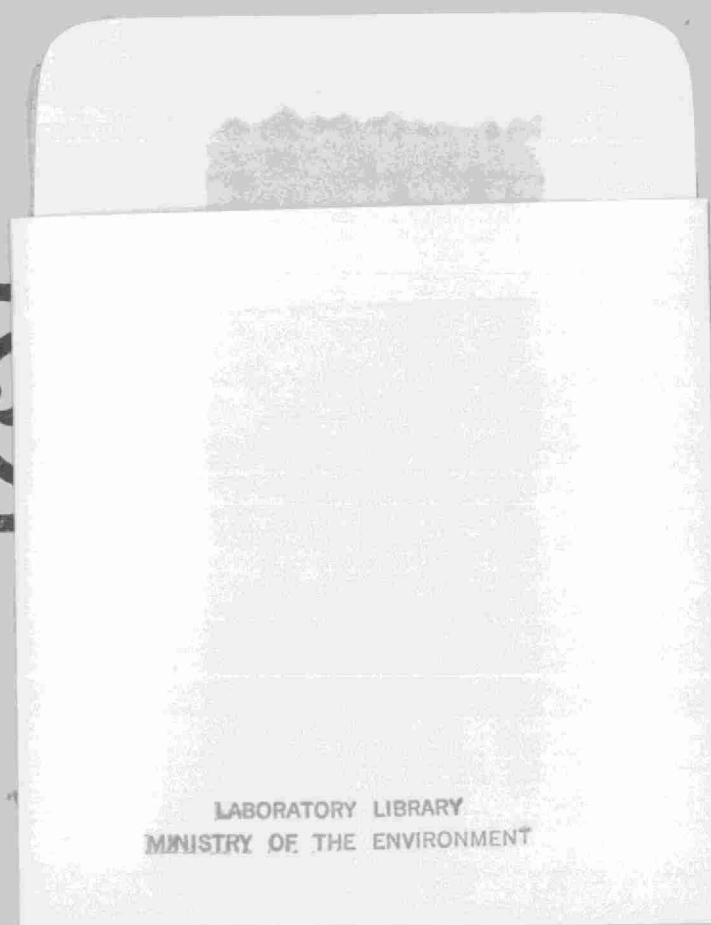
- Geis, J. W., 1979. Shoreline Processes Affecting the Distribution of Wetland Habitat. SUNY College of Environmental Science and Forestry, Syracuse, N.Y. Mimeograph.
- Harris, S. W., and W. H. Marshall, 1963. Biology of Water Level Manipulations on a Northern Marsh. Ecology Vol. 44(2):331-343.
- Jaworski, E., and C. N. Raphael, 1976. Modification of Coastal Wetlands in Southeastern Michigan and Management Alternatives. The Michigan Academician. pp. 303-317.
- Linde, A. F., T. Janisch, and D. Smith, 1976. Cattail - The Significance of its Growth, Phenology and Carbohydrate Storage to its Control and Management. Technical Bulletin No. 94. Dept. of Natural Resources, Madison, Wisconsin.
- Mathiak, H. A., 1971. Observations on Changes in the Status of Cattails of Horicon Marsh, Wisconsin. Research Report No. 66, Dept. of Natural Resources, Madison, Wisc. 17 pp.
- McDonald, M. E., 1955. Causes and Effects of a Die-off of Emergent Vegetation. J. of Wildlife Management 19:24-35.
- Millar, J. B., 1973. Vegetation Changes in Shallow Marsh Wetlands Under Improving Moisture Regime. Can. J. of Botany, 51:1443-1457.

FASTENER

LABORATORY LIBRARY



96936000119878



LABORATORY LIBRARY
MINISTRY OF THE ENVIRONMENT

Ontario



7530 - 1239

Letter size - 1/2 cut tab

▽